

RIA RFQ FINAL DRAWINGS

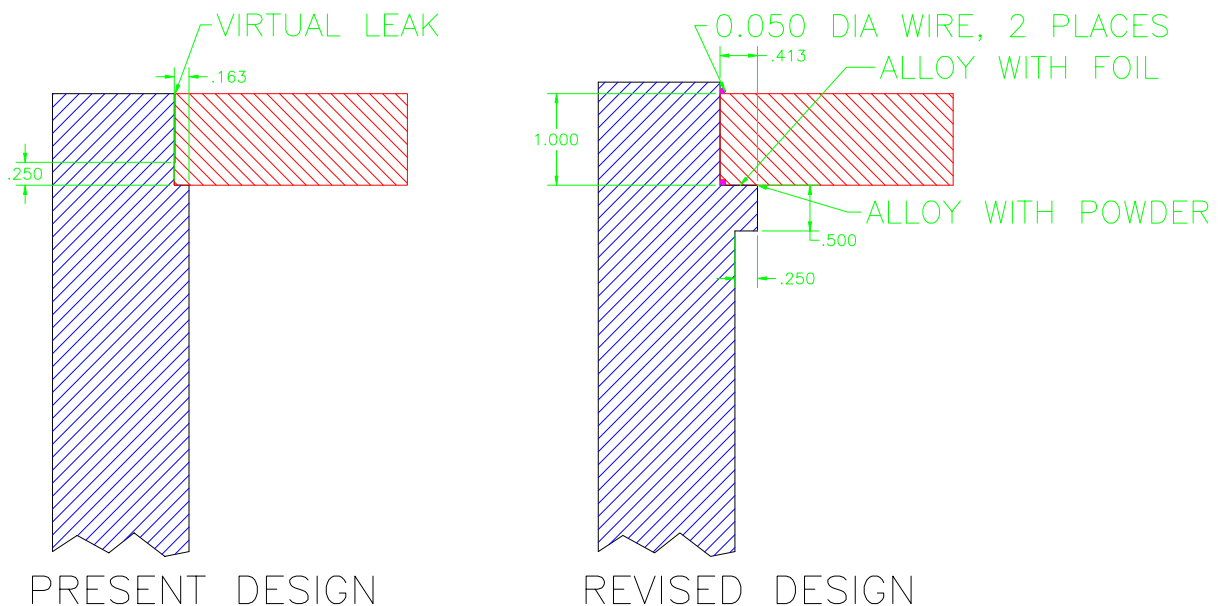
Review by W. Clark, F. Martinez, J. Rathke, & D. Schrage

John Rathke, Felix Martinez (LANL/LANSCE-1 Lead Braze Technician), and I had a chance to review the drawings when John visited LANL for a review of the NAVY FEL Photoinjector project. Felix, Bill Clark (LANL/LANSCE-1 Shop Supervisor), and I had another look at them this morning. Here are the comments that I noted from those discussions.

G12827: The braze joint at the end flange is undesirable as drawn. While the 0.163 inch joint width at the minimum distance from the 21.875 inch diameter cylinder on the barrel to the 22.200 inch octagon nearly meets the LANL 0.188 inch minimum width for a braze joint, it is not structurally robust. In fact, if one takes into account that there must be a chamfer at the inside corner to assure fit up, a 0.030 inch chamfer reduces the width of the braze joint to as little as 0.133 inch, far too small. The total area in brazed contact at the base of the flange will be about 30 square inches. In addition, having only a 0.250-inch length of the flange ID brazed leaves a virtual leak volume.

We had discussed putting an alloy groove into base of the upper flange and into the face of the lower cavity barrel. On closer examination, this is not feasible given the small areas. A better, more robust solution is shown on Figure I below:

Figure I: RIA RFQ END FLANGE BRAZE JOINT



PRESENT DESIGN

REVISED DESIGN

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LANL

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First, the full length of the inside diameter of the flange must be brazed. This will provide a more robust structure and eliminate the virtual leak. The RFQ barrel should stand proud about 0.125 inch. This will provide a place for the 0.050-inch diameter alloy to be wrapped. Adding some

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powder in this area would also be worthwhile. Alloy starvation will have an inconvenient consequence. It might be worthwhile to provide a small chamfer on the end of the barrel to aid in positioning the flange. This would be machined off when the ends of the RFQ segment are faced.

The RFQ barrel should have a thick feature at the ends. This will allow the braze joint to the flange to be about 0.250 inch wide at the narrowest point. This doubles the braze area at the base of the flange to nearly 50 square inches. Foil alloy (0.002 inch thick) should be placed at the base of the flange. In addition, there is a groove at the inner corner of the flange for 0.050-inch diameter foil alloy. Lastly, powder alloy can be placed at the outside of the RFQ barrel.

What is shown on Figure I is closer to the design that we used on the LEDA RFQ. The diametral clearance between the RFQ barrel and the inside diameter of the flange was 0.0002 to 0.0007 inch. This made for a very tight CuSil joint. Remember to machine the final bore of the flanges AFTER the ends of the RFQ barrel have been machined.

As far as alloying the structure, while it is probably ok to install the foil alloy at ANL prior to shipping the assembly to Bodycote, installation of the wire alloy is not a good idea. Felix is rather certain that the powder alloy will not stay in place during shipment. The wire and foil are best installed at Bodycote. For the LEDA RFQ, the unit was assembled (flanges installed) and alloyed while on the furnace base.

The fixturing should be strictly a ring that supports the flange. The ring should only support the flange and not touch the barrel. The 0.002-inch thick foil alloy will melt and flow and the 0.002-inch gap between the end of the barrel and the face of the flange will collapse. The upper flange should be weighted to assure that this joint will also collapse. As far as deflection of the vane tips during brazing, this is not an issue. If there is any concern about this, then a test could be run with the sample vane in the ANL furnace. There is no need to support the vane tips during the final braze. This would not be the case if the vane were in a horizontal orientation at braze temperature.

In zone A-6 (Detail C), it appears that the alloy groove will break out when the barrel of the RFQ is machined to accept the end flange. This would starve the end region of alloy.

G12826: The final machining tolerances on the end flanges (zone D3) are neither realistic nor necessary. These could be relaxed to about 0.003 inch with no problem.

G12832: There is a single datum ("C") on the base of the vanes and on the outside surface of the quadrant (G12834). While this provides a suitable axial datum, it does not constrain the part azimuthally. There should be two holes in the bottom of these parts to fully constrain them during machining.

G12829 & G12833: There are no dowel pins called out for assembly.

G12840: The "Lifting Plugs" and "Tube Braze Plugs" require chamfers at their bases to assure that they fit into the bores that they are to be brazed into. The "Lifting Plug" should be Item #3.

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G12837, G12838, & G12840: The radial clearance of the braze joints of the “Lifting Plugs” and “Tube Braze Plugs” can be up to 0.004 inch. That will required a volume of alloy of up to 0.002 square inches per inch. If the alloy is fed from wire, a diameter of 0.051 inch would be required.

G12835& G12836: Note #6 makes reference to a chamfer. There is no chamfer shown on the parts or plugs.

G12839 & G12830: We are not certain regarding the specified torques. But, 100 ft-# sounds a bit high. A simple test would be worthwhile.

GENERAL COMMENTS:

1. Stainless steel type 303 is called out in many locations. We use 304 and 316 because the lower sulphur content allows these to be welded to prior and after brazing. It is not clear whether or not the sulphur content of the type 303 material would affect the brazing. You might want to check with Bodycote on this.
2. There are a number of references to measurements to be made (e.g., Note #3 on G12828). Formal procedures and data sheets should be created in order to assure that these measurements are properly performed.
3. There are a number of instances where marking is specified (e.g., Note #1 on G12828). The drawings should be more specific with regard to this marking. For the LEDA RFQ, we had a formal memo specifying this and the drawings referred to the memo.
4. There needs to be a formal identification system for the segments and the vanes. Our convention has been to identify the lower vane as the datum and as “Vane #1.” For the LEDA RFQ, the lower vane of the first section was identified as Vane # A1V1 indicating that it was the datum (#1) vertical (V) of the first section of the first resonant segment (A1). We specified that the vanes be marked at the low energy end only. That assured identification of the specific vane and the low energy end.
5. You will want to provide cover plates for all of the openings so that vacuum leak testing can take place at Bodycote.